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Report of the first session of the

IPFC/IOFC AD HOC WORKING PARTY OF SCIENTISTS ON STOCK ASSESSMENT OF TUNA

Rome, 7-9 June 1972

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ROME, 1973

REPORT

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PREPARATION OF THIS REPORT

This is the revised version of the report presented to the Second Joint Meeting of the Indo-Pacific Fisheries Council's Special Committee on Management of Indo-Pacific Tuna and the Indian Ocean Fishery Commission's Committee on Management of Indian Ocean Tuna, held in Colombo, Sri Lanka, 5-6 October 1972.

Distribution

Participants
Members of the Indo-Pacific Fisheries Council
Members of the Indian Ocean Fishery Commission
Other interested nations and international organizations
FAO Department of Fisheries
FAO Regional Fishery Officers

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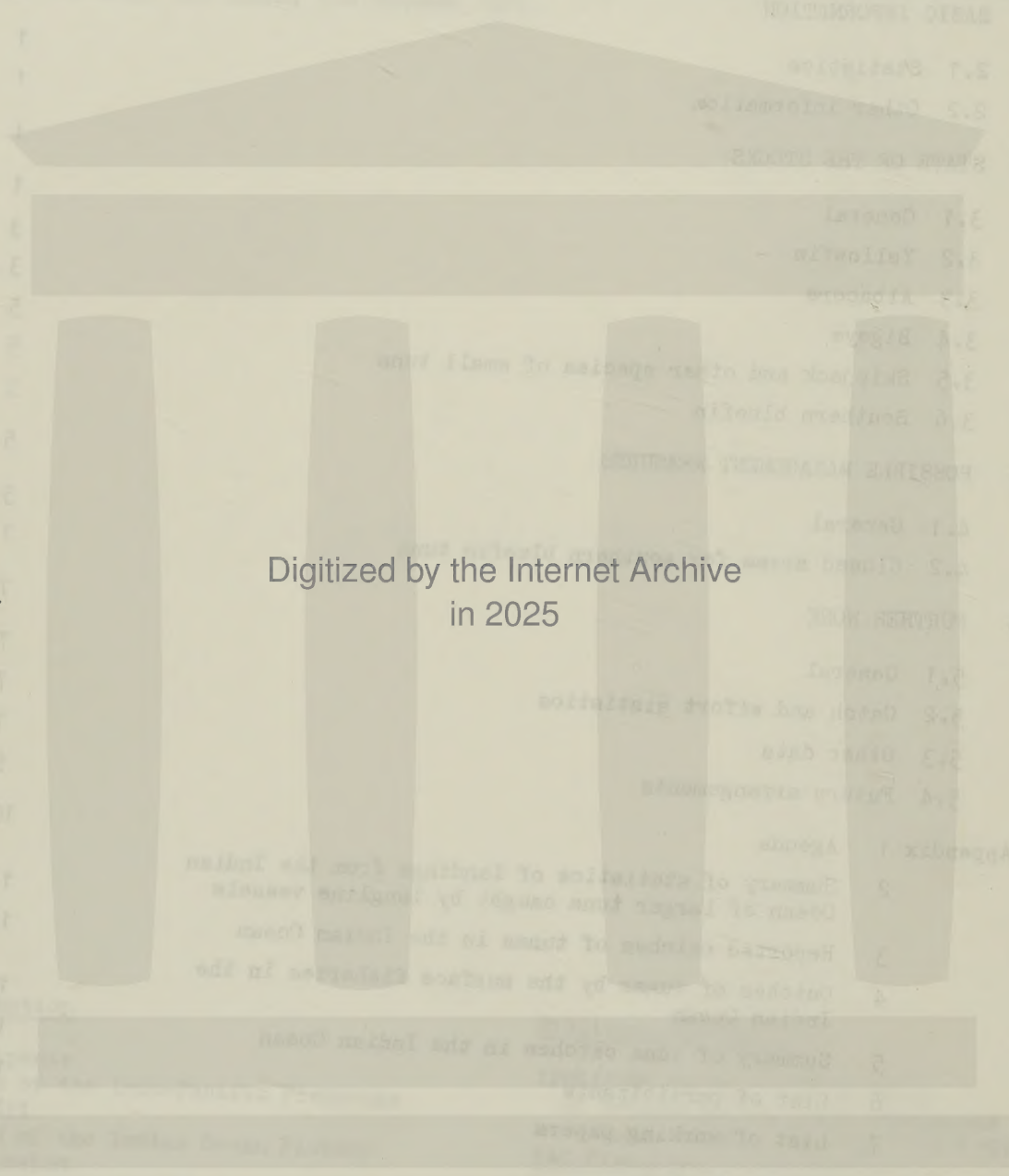
CONTENTS

		Page
1	INTRODUCTION	1
2	BASIC INFORMATION	1
	2.1 Statistics	1
	2.2 Other information	1
3	STATE OF THE STOCKS	1
	3.1 General	1
	3.2 Yellowfin	3
	3.3 Albacore	3
	3.4 Bigeye	5
	3.5 Skipjack and other species of small tuna	5
	3.6 Southern bluefin	5
4	POSSIBLE MANAGEMENT MEASURES	5
	4.1 General	5
	4.2 Closed areas for southern bluefin tuna	7
5	FURTHER WORK	7
	5.1 General	7
	5.2 Catch and effort statistics	7
	5.3 Other data	7
	5.4 Future arrangements	9
Appendix 1	Agenda	10
2	Summary of statistics of landings from the Indian Ocean of larger tuna caught by longline vessels	11
3	Reported catches of tunas in the Indian Ocean	12
4	Catches of tunas by the surface fisheries in the Indian Ocean	13
5	Summary of tuna catches in the Indian Ocean	14
6	List of participants	15
7	List of working papers	17



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1 INTRODUCTION

The Working Party met at FAO Headquarters, Rome, from 7-9 June 1972. Dr. J. Joseph was elected Chairman; Mr. E.L. Cadima acted as Technical Secretary; and Dr. W. Lenarz and Dr. J.A. Gulland were elected Rapporteurs. The provisional agenda (Appendix 1) was adopted. During the meeting discussions were concentrated on the stocks of tuna in the Indian Ocean, and the conclusions on the state of the stocks apply only to that ocean; however, the terms of reference of the Working Party, in relation to IPFC, also cover the western Pacific. The general remarks, especially those concerning future activities and the need to improve the supply of statistical and other basic data, apply with at least equal force to the Pacific.

2 BASIC INFORMATION

2.1 Statistics

Appendices 2 and 3 contain available catch statistics of fisheries for tunas in the Indian Ocean, as reported to FAO and published in the Yearbook of Fishery Statistics. Appendix 4 sets out amended catch statistics of surface fisheries for tunas in the Indian Ocean as estimated by the Working Party. Summaries of the total tuna catches, by all gears, are given in Appendix 5.

Footnotes attached to Appendices 2-4 indicate the difficulty in obtaining catch statistics of tuna fisheries in the Indian Ocean. It was particularly difficult to obtain catch statistics for the surface fisheries because these fisheries tended to be pursued by a large number of small vessels which landed their catches in numerous and scattered landing places.

The total standardized fishing effort by the combined longline fleets of Japan, Korea and Taiwan was calculated by Suda for each major species of tuna, taking into account the distribution of each species relative to the distribution of fishing effort. Effort data werealso available for the Australian surface fisheries for bluefin, and the drift net and troll fisheries of Sri Lanka. The trends in fishing effort may be seen in Figs 1-6, which show some of the interrelations between catch, effort, and catch-per-unit effort in these fisheries.

Delegates from Sri Lanka and Madagascar indicated that the surface fisheries of their countries were expanding.

2.2 Other information

Age composition data as estimated from length frequencies from the Japanese longline fisheries utilizing age/length keys obtained from Pacific Ocean samples were presented by Suda (6), and Honma and Suzuki (5). Length frequencies of yellowfin captured by the surface fishery of Sri Lanka were presented by Sivasubramaniam (1). Members of the Working Party noted that age-length keys were probably not very accurate for tunas and suggested that length frequencies either as percentages, or as numbers per unit effort, should be supplied in addition to the age composition data. It was also noted that additional analysis could have been made if age and length frequencies had been made available by area and year.

3 STATE OF THE STOCKS

3.1 General

It was agreed that in general data were insufficient to evaluate interactions between surface and longline fisheries. There was also a need to develop theoretical models to treat this problem of interaction.

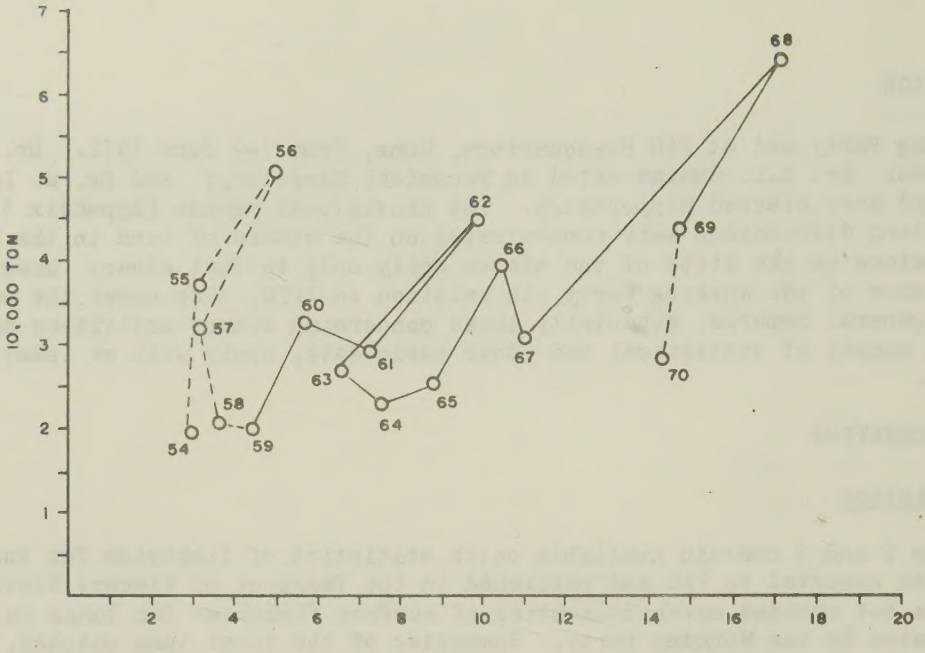

Fig. 1 Relation between total catch of yellowfin tuna in the Indian Ocean long-line fisheries and the standardized fishing effort (from Fig. 6 of Suda (6), and Fig. 12 of Honma and Suzuki (5))

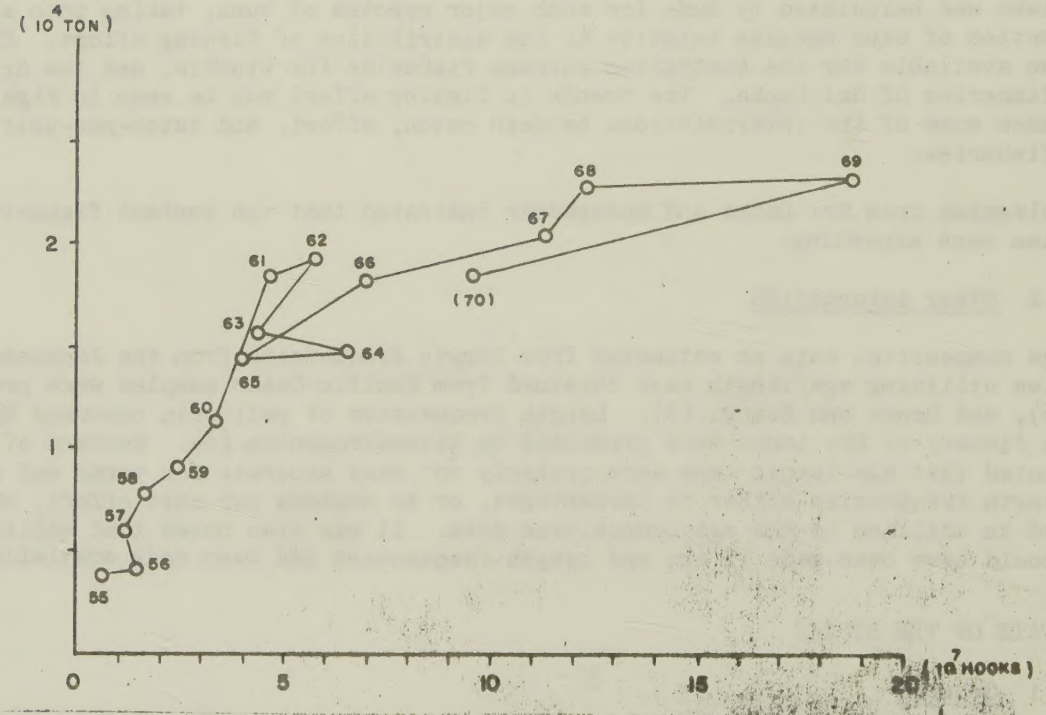

Fig. 2 Relation between total catch of albacore tuna in the Indian Ocean long-line fisheries and the standardized fishing effort (from Fig. 5 of Suda (6))

3.2 Yellowfin

Suda (6), and Honma and Suzuki (5), concluded from analysis of longline data that:-

(i) increased effort would not increase longline catch of yellowfin (Fig. 1);

(ii) recruitment had not been affected by fishing (Fig. 7, taken from Fig. 13 of Honma and Suzuki (5);

(iii) considerable year to year variations appeared to be independent of effort and perhaps were caused by natural variability and recruitment. Thus forecast of annual catches for quota purposes would be difficult.

Honma and Suzuki (5) cautioned that conclusion (ii) possibly might not be valid because there had probably been a shift in effort towards small yellowfin as the catch rate had stayed higher for small fish than for large fish and effort had shifted towards the western Indian Ocean which had small fish, as shown by the average size of fish in the Japanese longline fishery in the period 1966-69. It was noted that the longline fishery of Sri Lanka during the period 1968-70 captured relatively large fish in the central region, smaller fish in the eastern region, and the smallest fish in the western region. It was also noted that since inception of the longline fishery in the Pacific there had been a tendency to capture larger yellowfin in the central Pacific than in the western Pacific; however, it was further noted that fishing intensity appeared to be higher in the western Indian Ocean than in the eastern because catches of yellowfin were higher in the former. Thus the smaller average size in the western region might be due to higher fishing mortality. It was suggested that examination of catch, effort, and size composition data by area and year might prove fruitful.

Honma and Suzuki (5) concluded that the average age of recruitment to the longline fishery was 2.5 years. Fig. 7 indicates that at high values of F the optimum average age of recruitment is about 2.5 years. They therefore concluded that the yield-per-unit recruitment to the longline fishery would not be increased by any change in the size at first capture. It was suggested that the difference in size by region might indicate the presence of more than one stock. Thus, the present position on the yield-per-recruit isopleths might be different in the two regions; however, it was agreed that the theoretical advantages of management based on the presence of more than one stock should be evaluated before the extremely difficult problem of stock identification was attacked. To this end, it was recommended that analyses should be made of the effect of fishing, treating each area separately. The implications of the results of these analyses for the management of the fisheries should then be examined. If these results suggested different management actions from those obtained by treating all the fish of a given species in the Indian Ocean as a single stock, then the problem of stock identification should be given high priority, but otherwise not.

It was noted that very scanty data were available from the surface fisheries even though the surface fisheries had been estimated as capturing 25% of the total catches in 1970.

3.3 Albacore

Size composition data from Japanese longline catches of albacore were presented by Suda (6) which indicated that only large albacore were caught north of 30°S, while both small and large albacore were caught south of 30°S. Fig. 2 (from Fig. 5 of Suda (6)) indicates that an increase in longline effort beyond 100 000 000 standard hooks would not result in an increased catch of albacore. In recent years effort for albacore has shifted from the northern region to the southern region. This may have some effect on the interpretation of Fig. 2. This change in fishing area has resulted in a reduced size of first capture, but this has had no significant effect on the yield of the fishery. This is in agreement with Suda's study of the yield per recruit.

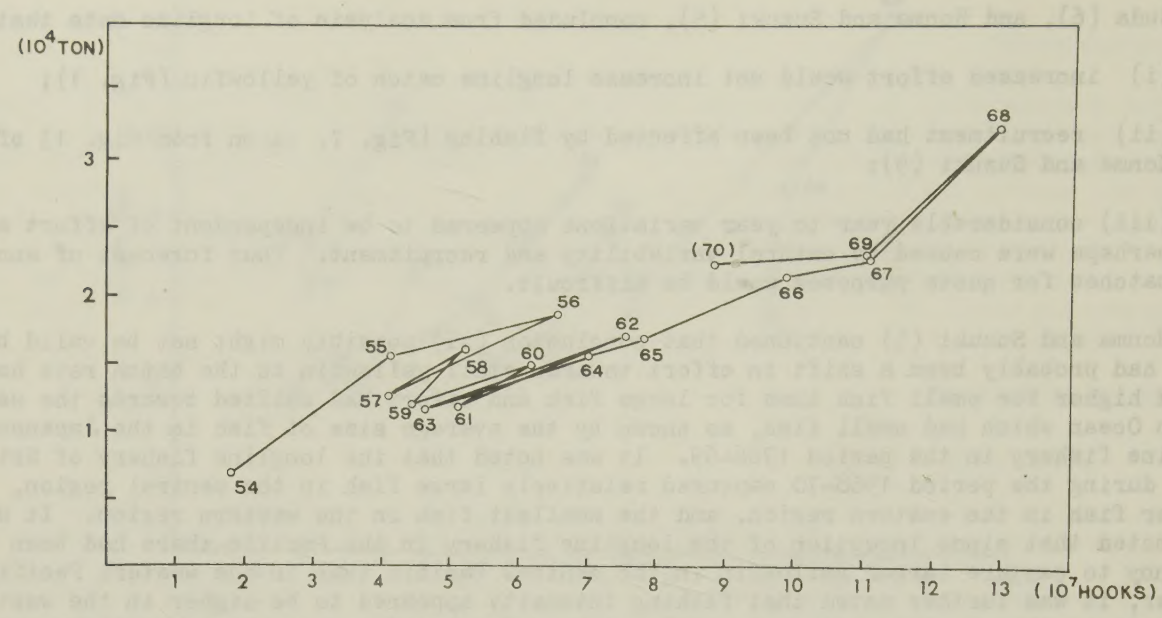

Fig. 3 Relation between total catch of bigeye tuna in the Indian Ocean long-line fisheries and the standardized fishing effort (from Fig. 7 of Suda (6))

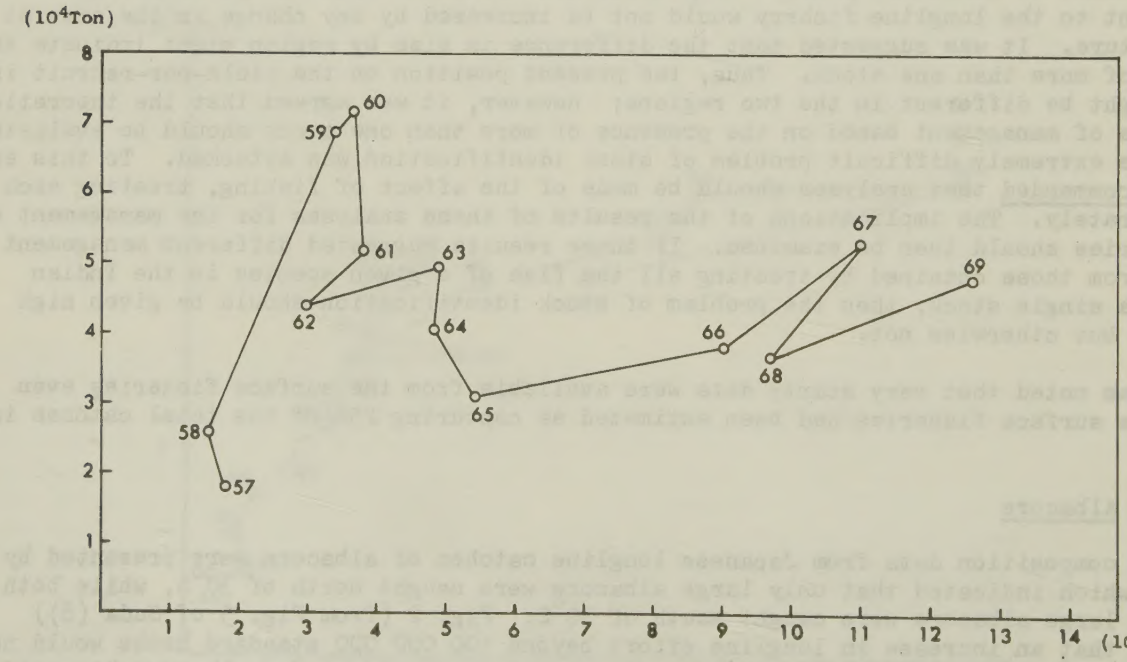

Fig. 4 Relation between total catch of southern bluefin tuna in the Indian Ocean long-line fisheries and the standardized fishing effort (from Fig. 8 of Suda (6))

It was noted that some investigations have suggested the possibility of interchanges of albacore between the south Atlantic and Indian Oceans. The significance of this has not yet been determined.

3.4 Bigeye

Suda (6) noted that the relative abundances of ages 5 and 6 bigeye had decreased; that age 4 had remained constant; and that ages 2 and 3 had increased. This suggests that increased fishing mortality has occurred for older bigeye, and that recruitment has remained constant or increased; however, the fishery has expanded to the area south of 30°S, which contains smaller bigeye than the area north of 30°S. Suda (6) used two methods to estimate that the maximum sustainable yield (MSY) of bigeye is between 30 000 and 32 000 m tons. He concluded that these results and the recent catch history suggested that the stock was not presently being overfished, but it was unlikely that increases in effort would produce substantial increases in catch. It was also considered unlikely that any significant surface fishery would develop on this species.

3.5 Skipjack and other species of small tuna

The Working Party concluded that it would need to have improved statistics before it could make a rational attempt at stock assessment for these species.

Sri Lanka noted that it planned to increase its skipjack fishery in the next five years. Skipjack larvae are relatively much more abundant than those of other tuna. The potential yield of skipjack from the Indian Ocean is probably large, and considerably in excess of present catches; however, the present catches are not insignificant and come from a restricted area to the west and south of Sri Lanka, and if these fish form a local stock the possibilities for increase in these local fisheries may not be good. On the other hand, evidence from the Pacific suggests mixing over a wide area.

The stock assessment of these species should be coordinated with the FAO Indian Ocean Development Programme.

3.6 Southern bluefin

Members expressed concern that detailed data of the Australian surface fishery were not available to the meeting, and hoped that this data would soon be available. They requested FAO to take all appropriate action to obtain these data, and to circulate summaries to the members of the Working Party.

Fig. 4 from Suda (6) indicates that increases in longline effort towards southern bluefin have not resulted in increased catches. Catch per effort of the Australian surface fishery (Fig. 5) has remained relatively constant. Average size of southern bluefin in the longline catch has only decreased slightly over the years, but Hayasi, Shingu and Hisada (4) concluded that the size of the spawning stock had decreased greatly, e.g. the relative abundance off Western Australia was only 1/7 of that of the virgin stock.

4 POSSIBLE MANAGEMENT MEASURES

4.1 General

The detailed assessments in the previous section show that in the longline fisheries increased fishing would not give any appreciable increase in yield from three species (yellowfin, albacore and bluefin). For these species there might well be economic benefit from preventing further increases in effort. The problems of such controls in the amount of fishing were not discussed during the meeting, but the remarks made by the meeting of the IOFC Working Party on Stock Assessment in Relation to Immediate Problems of Management in the Indian Ocean (FAO Fisheries Report 82, section 2.1.3) should be noted in this connection.

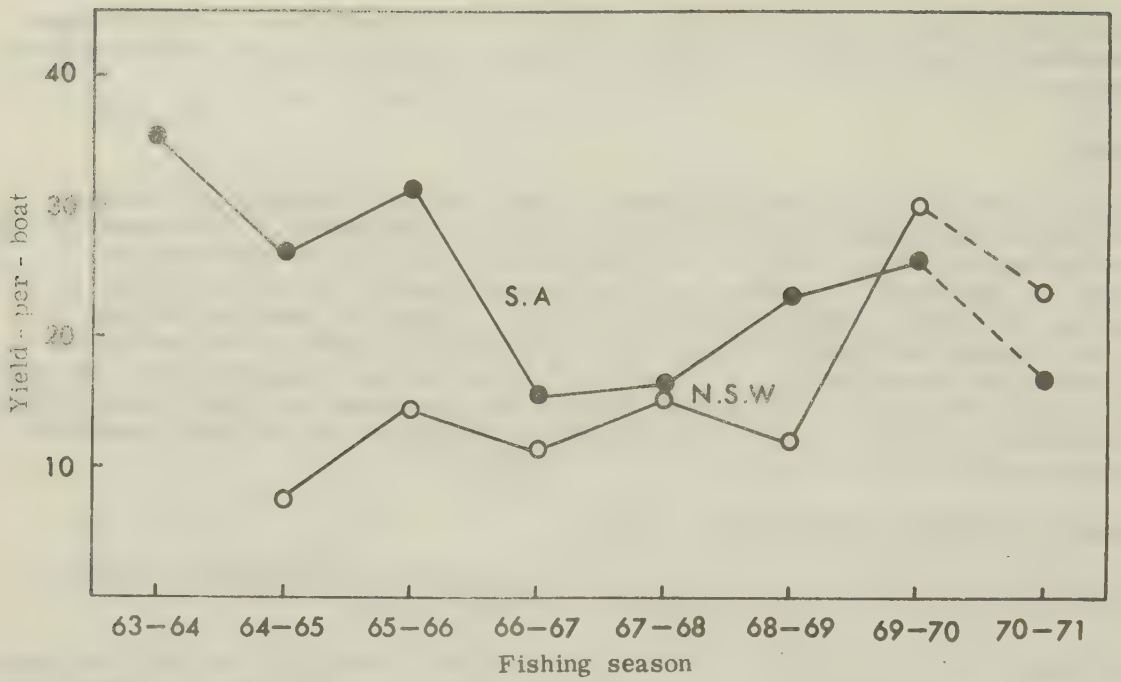

Fig. 5 Trends in catches per unit effort of southern bluefin tuna in the Australian surface fisheries (from Fig. 9 of Suda (6))

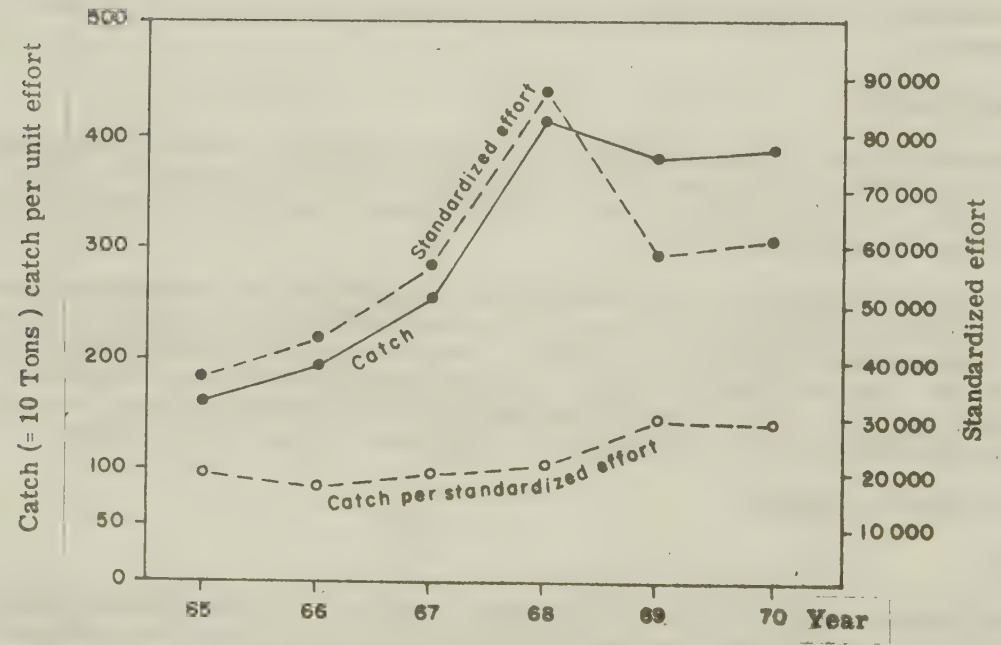

Fig. 6 Changes in catch, effort, and catch per unit effort in the surface fishery for yellowfin around Ceylon (from Fig. 6 of Sivasubramaniam (1)).

4.2 Closed areas for southern bluefin tuna

In section 3.6 it was shown that the abundance of the spawning stock of bluefin has been reduced to a low level. Though the quantitative effect of this reduction on subsequent recruitment is not known, any measure to check or reverse this decline would reduce the possibility of any catastrophic fall in recruitment. An increase in the age of first capture in the longline fishery would tend to increase the spawning stock, as well as increase the yield per recruit. One method of doing this is to close the fishing areas in which mainly small fish are caught.

The Japan Tuna Fishermen's Association has decided to take measures to close four areas for various durations, mainly to refrain from catching young southern bluefin. Monitoring of the location of longline vessels by fixing position from daily radio reports indicates that the regulations are being followed. About 20% of the effort that normally fishes for southern bluefin has shifted its operations to other regions that include the north Atlantic in an attempt to shift effort from southern bluefin to bigeye. The Far Seas Fisheries Research Laboratory has assigned one investigator to the port that handles the major portion of southern bluefin landings to measure the effects of the regulations. Suda (1), and Hayasi et al (4), estimate that the closed areas should initially result in a decline of about 1 800 tons in landings, but that the landings should recover to a level a little above the original levels after two to three years. They also estimate that the stock fecundity will increase by 3.5%.

5 FURTHER WORK

5.1 General

The Working Party stressed that while the assessments presented in section 3 were the best presently available, and were sufficient to answer some of the questions arising in Indian Ocean fisheries, e.g. longline catches of tunas could not be increased, except for some increase in catch of bigeye, whereas catches of skipjack could be substantially increased the results were not sufficient to answer the more pressing and urgent questions likely to arise in the next few years. Answering these questions required making the proper arrangements now for collecting the essential basic data, and for its compilation and analysis.

5.2 Catch and effort statistics

Catch and effort statistics, particularly for the surface fisheries, need to be improved. It was noted that a report had been prepared for the FAO Indian Ocean Development Programme on the problems of statistics in the Indian Ocean fisheries which identified the inadequacies of fishery statistics in general in the area and made some recommendations for improvement.

5.3 Other data

In most cases size composition statistics are lacking from the surface fisheries and those from the longline fisheries also need considerable improvement. It was suggested that, in addition to estimates of age composition, length frequency data should be made available from longline fisheries. It was also noted that there might be a problem in identifying tunas less than 40 cm because identification keys were not available. The Working Party recommended that the Expert Panel for the Facilitiation of Tuna Research be requested to produce such a key. It was pointed out that better coordination was needed in the collection and analysis of data. A need was expressed for defining the specific nature of the problems pertaining to analysis and collection of data. It was suggested that forms for recording and reporting data similar to those used by the International Commission for Conservation of Atlantic Tunas (ICCAT) should be created. It was also noted that in addition to identifying the detailed requirements it might be necessary to provide technical assistance to some countries to help them fulfil these requirements for both catch and effort statistics and other data.

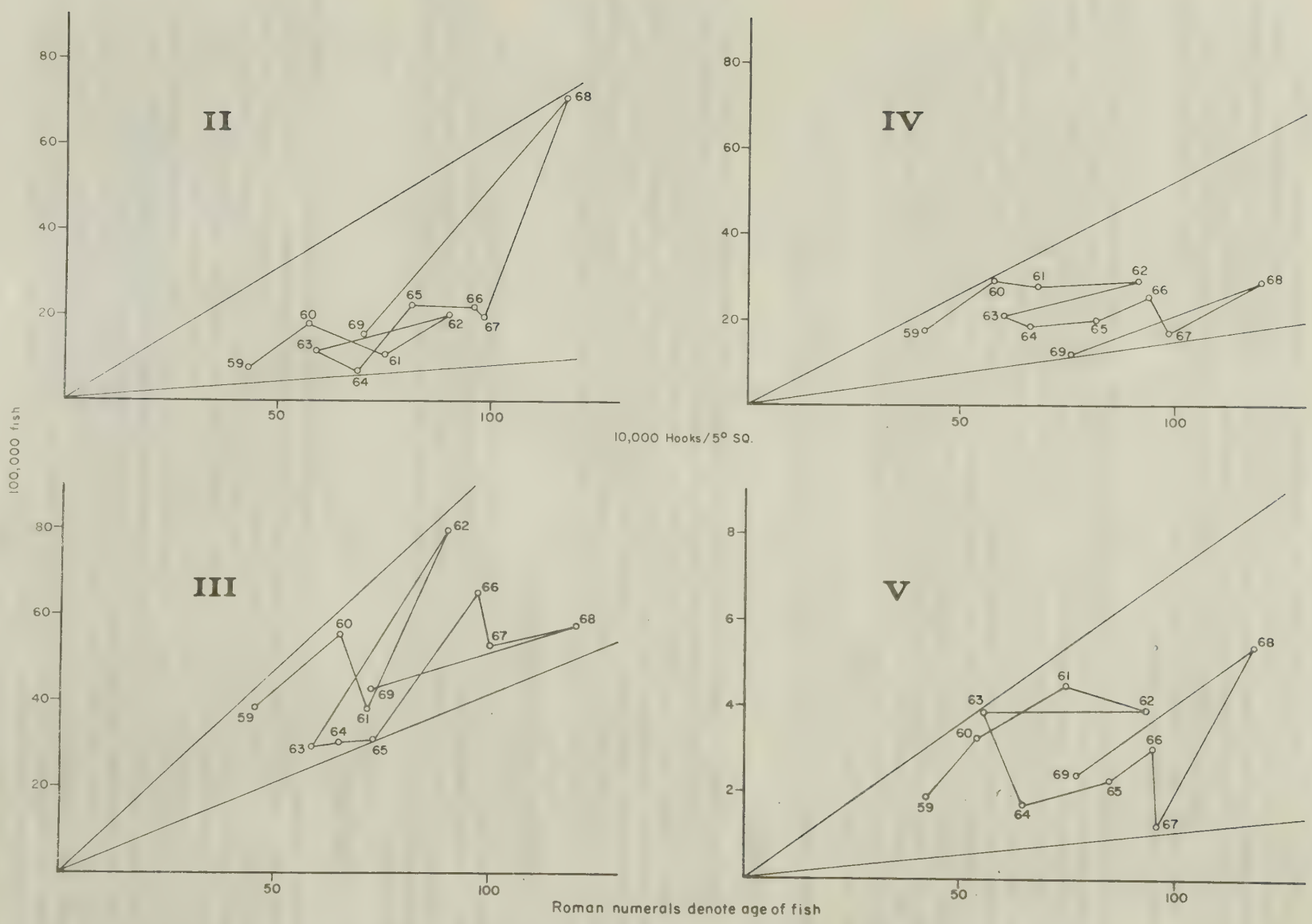

Fig. 7 Relation between catches of different age-groups of yellowfin tuna, and total long-line effort (from Fig. 13 of Honma and Suzuki (5)).

5.4 Future arrangements

The Working Party identified, among other tasks, the following distinct fields of activity for which provision should be made by IOFC/IPFC and their member governments.

5.4.1 Close coordination is necessary on a continuing basis in the assessment of tuna stocks, including the collection of basic data, and the identification of the current obstacles to improved assessments. This might well be carried out by the present Working Party, or a similar group, established on a permanent basis. Pending a permanent arrangement the Working Party suggested that it should continue its activities on an interim basis. It could be expected that most of the work could be done by correspondence. To facilitate the work it was recommended that each member country appoint a national scientist as correspondent to the Working Party.

5.4.2 To be effective, the activities of the Working Party would need to be supplemented by considerable central support ranging from the usual secretarial services, through the tabulation of statistical and related data as submitted to the secretariat, to active field work in data collection and technical assistance to member countries. The Working Party emphasized that a considerable volume of work was involved. Judging by the work involved in bringing the statistics of the Atlantic tuna fishery up to the desired quality, as is being done by ICCAT, a staff of several professionals, plus supporting staff would be required. If staff on this scale could not be provided, the Working Party felt that one professional (with full provision for travel in the region) could make a useful start towards improving the present provision of statistics, and facilitating the work of the Working Party. The Working Party did not feel that it was competent to make detailed recommendations on how this work, whether of one man or of a larger and more effective group, could be financed; rather it wished to draw the attention of IOFC and IPFC to the situation, and strongly recommended that these bodies examine, as a matter of urgency, ways in which the necessary support could be provided.

5.4.3 The major work in collecting statistics and biological data could be done nationally. The Working Party emphasized that with few exceptions the present staff, money and time employed by countries was inadequate to permit accurate assessments of the state of the tuna stocks to be made, and therefore recommended to the member countries of IOFC and IPFC that they should consider allotting greater resources to this essential work.

* * * * *

Appendix 1

AGENDA

1 Election of Chairman

2 Adoption of Agenda

3 Review of statistics of tuna fisheries
   (a) Longline fisheries
   (b) Other fisheries

4 Review of other information
   (a) Biological sampling (length/age, etc.)
   (b) Published studies

5 Present status of tuna stocks
   (a) Southern bluefin tuna, including the interaction between fisheries
   (b) Yellowfin
   (c) Albacore
   (d) Bigeye
   (e) Skipjack
   (f) Other species

6 Effects of possible management measures
   (a) Closed areas/seasons in the southern bluefin fishery
   (b) Control of the total amount of fishing in the longline fishery
   (c) Other measures

7 Future activities: statistics
   (a) Timeliness
   (b) Required standards for reporting
   (c) Arrangements for reporting, compilation and dissemination

8 Future activities: other

9 Adoption of report

10 Any other business

* * * * * *

Appendix 2

SUMMARY OF STATISTICS OF LANDINGS FROM THE INDIAN OCEAN OF LARGER TUNA CAUGHT BY LONGLINE VESSELS
(thousand metric tons)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Albacore												
Thunnus alalunga												
China (Taiwan)	...	...	...	...	0.2	0.0	1.4	2.9	5.3	7.1	7.6	5.0
Japan	12.9	16.8	22.8	15.6	15.3	14.2	12.4	15.3	10.1	11.2	6.3	3.3
Korea, Rep.of	-	-	-	-	-	0.5	0.5	2.9	0.6	4.3	(2.3)	
USSR (c)				(0.1)	(0.4)	(0.7)	(1.5)	(1.3)	(1.8)	(1.3)	(1.4)	
Total	12.9	16.8	22.8	15.7	15.9	15.4	15.8	22.4	17.8	23.9	17.6	
Bigeye tuna												
Thunnus obesus												
China (Taiwan)	...	...	...	...	1.8	1.3	0.5	2.6	6.9	6.3	5.3	6.5
Japan	9.9	11.1	18.2	15.2	13.4	15.5	17.4	21.9	22.8	16.9	12.5	10.5
Korea, Rep.of	-	-	-	-	-	0.1	0.1	0.2	5.4	3.1	(1.7)	
Sri Lanka	-	-	-	-	-	-	0.1	0.1	0.2	0.2	0.1	0.1
USSR (c)				(0.1)	(0.4)	(0.7)	(1.5)	(1.3)	(1.8)	(1.3)	(1.3)	
Total	9.9	11.1	18.2	15.3	15.6	17.6	19.6	26.1	37.1	27.8	20.9	
Yellowfin tuna												
Thunnus albacares												
China (Taiwan)	...	...	...	...	2.8	2.2	1.6	4.3	18.2	16.7	14.8	13.1
Japan	33.2	29.8	41.7	26.7	17.3	20.9	27.2	27.3	39.9	22.7	10.9	12.3
Korea, Rep.of	-	-	-	-	-	0.0	0.1	0.2	4.0	6.1	(3.3)	
Sri Lanka	-	-	-	-	0.2	0.2	0.2	0.3	0.4	0.4	0.3	0.2
USSR (c)				(0.1)	(0.3)	(0.7)	(1.4)	(1.3)	(1.7)	(1.3)	(1.3)	
Total	33.2	29.8	41.7	26.8	20.6	24.0	30.5	33.4	64.2	47.2	30.6	
Southern bluefin tuna												
Thunnus maccoyi												
China (Taiwan)	-	-	-	-	-	-	-	0.0	0.2	0.2	0.2	0.0
Japan (a)	46.5	42.2	23.6	23.2	22.0	21.7	13.4	27.8	26.8	28.1	19.5	20.1
(b)	6.0	15.0	9.3	25.6	23.6	15.1	19.0	17.8	17.9	18.0	19.2	
Total	52.5	57.2	32.9	48.8	45.6	36.8	32.4	45.6	44.9	46.3	38.9	
Total (major species)	108.5	114.9	115.6	106.6	97.7	93.8	98.3	127.5	164.0	145.2	108.0	
Unspecified												
Korea, Rep.of										16.1	8.8	

(a) Catches in Indian Ocean

(b) Catches in south Atlantic and south Pacific, probably from the same stock

(c) USSR catch split equally between albacore, bigeye and yellowfin

... Data not available; unobtainable; not submitted in time for inclusion

\- None; magnitude known to be nil or zero; given in original source as "nil or negligible" without any further indication of the magnitude

Figures in brackets are estimates made by the Working Party

Appendix 3

REPORTED CATCHES OF TUNAS IN THE INDIAN OCEAN

(As given in FAO Yearbook of Fishery Statistics, Volume 22, excluding catches of large tuna in the longline fisheries.)

(thousand metric tons)

	1964	1965	1966	1967	1968	1969	1970
Oriental bonito *Sarda orientalis*							
Maldives (a)	8.0	13.1	15.9	17.9	16.3	18.4	18.4
Frigate mackerel *Auxis thazard*			None reported				
Oceanic skipjack *Katsuwonus pelamis*							
Japan	0.0	0.1	0.1	0.2	0.3	0.3	0.1
Southern bluefin tuna *Thunnus maccoyi*			None reported				
Yellowfin tuna *Thunnus albacares*							
Maldives	0.5	1.0	1.5	1.7	1.7	1.8	1.8
Albacore *Thunnus alalunga*			None reported				
Bigeye tuna *Thunnus obesus*			None reported				
Eastern little tuna *Euthynnus affinis*			None reported				
Various tuna-like fishes							
Australia (b)	5.5	4.8	6.1	3.5	3.1	3.7	2.6
India (c)	5.1	3.5	3.1	3.7	3.8	3.4	3.1
Madagascar	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Malaysia (West)	0.0	0.0	0.6	0.9	0.8	0.8	1.4
Maldives (a)	1.5	2.5	3.0	3.5	3.5	3.6	3.6
Pakistan	9.6	10.1	12.2	11.0	11.2	11.2	12.8
Reunion	0.1	0.1	0.1	0.2	0.3	0.4	0.4
Sri Lanka	22.7	25.6	30.0	42.8	56.5	51.8	33.9
Yemen, Peo.Dem.Rep.of (e)	3.6	2.5	1.5	1.3	1.6	1.6	1.6
Total	56.6	63.3	74.1	86.7	99.1	97.0	79.7

(a) Information from Sivasubramaniam based on exports to Sri Lanka suggests total catch is 25 - 30 000 tons, mostly skipjack and some yellowfin

(b) Nearly all southern bluefin; total in Annex IV includes catches in southwest Pacific

(c) Detailed species composition supplied for the meeting by India for 1969-71. Virtually all skipjack and *Euthynnus*

(d) Detailed species composition provided by Sivasubramaniam

(e) Believed to be about 20% skipjack and the rest *Euthynnus*

Appendix 4

CATCHES OF TUNAS BY THE SURFACE FISHERIES IN THE INDIAN OCEAN

(thousand metric tons)

	1964	1965	1966	1967	1968	1969	1970	1971
Frigate mackerel *Auxis thazard*								
Sri Lanka	4.0	4.5	4.5	5.0	5.0	5.5	5.0	
Yellowfin tuna *Thunnus albacares*								
Maldives	Annual catches about 5.0							
Sri Lanka	2.0	1.7	2.0	2.6	4.1	3.8	4.5	
Somalia	Variable catches: annual average about 1.000 tons							
Indonesia (f)	Annual catches 3 - 5 thousand tons							
Oceanic skipjack *Katsuwonus pelamis*								
India (a)	(1.0)	(0.7)	(0.6)	(0.7)	(0.7)	(0.6)	0.6	1.2
Maldives	Average in recent years 25.0 - 30.0							
Pakistan (b)	(2.0)	(2.0)	(2.4)	(2.2)	(2.2)	(2.2)	(2.6)	
Sri Lanka	2.0	2.5	3.0	3.7	7.0	13.0	15.0	
Yemen, Peo.Dem.Rep.of	(0.7)	(0.5)	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	
Indonesia (f)	Annual catches 10 - 12 thousand tons							
Southern bluefin tuna *Thunnus maccoyi*								
Australia (c)	7.7	6.8	8.2	6.3	8.8	8.4	6.4	6.3
Eastern little tuna *Euthynnus affinis*								
India (a)	(4.4)	(2.8)	(2.5)	(3.0)	(3.1)	2.8	2.3	4.5
Pakistan (b)	(7.6)	(8.1)	(9.8)	(8.8)	(9.0)	(9.0)	(10.2)	
Sri Lanka	3.0	3.0	3.0	3.5	4.0	4.0	4.0	4.0
Yemen, Peo.Dem.Rep.of	2.9	2.0	1.2	1.0	1.3	1.3	1.3	1.3
Total (d)	67.7	65.0	67.4	66.5	73.5	81.4	84.3	

(a) Assuming species composition 1964-68, 20% skipjack, 80% *Euthynnus*

(b) Assuming species composition is same as for India

(c) Includes southwest Pacific

(d) Annual catch of Maldives is taken as 30 000 tons. Figures exclude Indonesia

(e) Discrepancies between the total in this table (believed to be the more reliable) and Annex III are due, in the main to (i) under-reporting of the Maldives catch in Annex III, and (ii) the Sri Lanka figures in Annex III which include catches of bill-fishes, carangids, and other mackerel-like fishes

(f) Figures include all catches in Indonesia waters, of which only a small proportion is taken in the Indian Ocean proper, but some of the rest may be from Indian Ocean stocks

Figures in brackets are estimates made by the Working Party

Appendix 5

SUMMARY OF TUNA CATCHES IN THE INDIAN OCEAN

(thousand metric tons)

		1964	1965	1966	1967	1968	1969	1970
Albacore *Thunnus alalunga*	longline	15.9	15.4	15.8	22.4	17.8	23.9	17.6
Bigeye tuna *Thunnus obesus*	longline	15.6	17.6	19.6	26.1	37.1	27.8	20.9
Yellowfin tuna *Thunnus albacares*	longline	20.6	24.0	30.5	33.4	64.2	47.2	30.6
	surface (b)	7.0	6.7	7.0	7.6	9.1	8.8	9.5
	total	27.6	30.7	37.5	41.0	73.3	56.0	40.1
Southern bluefin tuna *Thunnus maccoyi*	longline	45.6	36.8	32.4	45.6	44.9	46.3	38.9
	surface	8.1	7.2	8.1	5.7	6.8	8.9	8.5
	total	53.7	44.0	40.5	51.3	51.7	55.2	47.4
Oceanic skipjack *Katsuwonus pelamis*	surface (a)	30.7	30.7	31.3	31.9	35.2	41.1	43.5
Frigate mackerel *Auxis Thazard*	surface	4.0	4.5	4.5	5.0	5.0	5.5	5.0
Eastern little tuna *Euthynnus affinis*	surface	17.9	15.9	16.5	16.3	17.4	17.1	17.8
Total	longline	97.7	93.8	98.3	127.5	164.0	145.2	108.0
	surface	67.7	65.0	67.4	66.5	73.5	81.4	84.3
	all methods	165.4	158.8	165.7	194.0	237.5	226.6	192.3

(a) Small quantities of skipjack are also taken by longline. Annual catch of Maldives is taken as 25 000 tons. Excludes Indonesia

(b) Excluding Somalia and Indonesia

Appendix 6

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Appendix 7

LIST OF WORKING PAPERS

A. Published Paper

(1) Sivasubramaniam, K., 1970 Surface and subsurface fisheries for young and immature yellowfin tuna (T. albacares) around Ceylon. Bull.Fish.Res.Stn.Ceylon, 21(2):113-22

B. Mimeograph Reports

(2) Hayasi, S., 1972 A supplemental note on estimation and treatment of parameters in dynamics of fishery populations.

(3) Hayasi, S., M. Honma & Z. Suzuki, 1972 A comment on rational utilization of yellowfin tuna and albacore stocks in the Atlantic Ocean.

(4) Hayasi, S., C. Shingu & K. Hisada, 1972 An inference on rational utilization of southern bluefin tuna based on data obtained from 1957 to 1969.

(5) Honma, M. and Z. Suzuki, 1972 Preliminary assessment of yellowfin tuna stock in the Indian Ocean taken by longline fishery 1959-1969.

(6) Suda, A., 1972 Observations on the recent status of the tuna longline fishery in the Indian Ocean.

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